This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims

1. (previously presented) A method for forming an ONO structure, comprising:

providing an oxide-nitride film on a surface of a substrate, the oxide-nitride film including a first oxide layer over the substrate and a silicon nitride layer over the first oxide layer;

patterning the oxide-nitride film to define bottom oxide and silicon nitride portions of an ONO stack on the substrate, the bottom oxide and silicon nitride portions having exposed sidewalls and the silicon nitride portion having an exposed surface; and

performing a ISSG operation by heating the substrate to a temperature in a range about 700 °C to about 1300 °C and exposing the exposed sidewalls and the exposed surface to a gas mixture comprising O_2 and H_2 in a proportion in a range about 0.1% to about 40% (H_2 / H_2 + O_2) at a pressure in a range about 1 torr to about 20 torr for a time in a range about 1 to 1000 seconds, whereby components of the gas mixture react to produce a radical oxidizing agent near the heated substrate, to form an oxide layer on the exposed surface and sidewalls of the patterned silicon nitride portion and on the sidewalls of the patterned bottom oxide portion.

2. (original) The method of claim 1 wherein the radical oxidizing agent comprises an oxygen radical.

3. (original) The method of claim 1 wherein the radical oxidizing agent comprises $O^{\bullet}$.

4. (cancelled)

5. (canceled)

6. (previously presented) The method of claim 1 wherein heating the substrate comprises heating the substrate to a temperature in a range about 900 °C to about 1150 °C.

7. (previously presented) The method of claim 1 wherein heating the substrate comprises heating the substrate to a temperature in a range about 850 °C to about 1000 °C.

8. (previously presented) The method of claim 1 wherein the exposing comprises heating the substrate to a selected temperature in the temperature range and exposing the exposed sidewalls and the exposed surface to a gas mixture comprising O_2 and H_2 in a proportion in a range about 0.1% to about 40% (H_2 / H_2 + O_2) at a pressure in a range about 1 torr to about 20 torr for a time in a range about 1 to 1000 seconds, whereby components of the mixture comprising O_2 and H_2 react to produce $O^{\bullet}$ near the heated substrate.

9. (canceled)

10. (canceled)

11. (canceled)

12. (previously presented) The method of claim1 wherein the exposing comprises flowing over the heated substrate a gas mixture comprising O_2 and H_2 in a proportion in a range about 5% to about 33% (H_2 / H_2 + O_2).

13. (previously presented) The method of claim 1 wherein the exposing comprises flowing over the heated substrate a mixture comprising O_2 and H_2 in a proportion in a range about 1:19 to about 1:2 (H_2 : O_2).

14. (previously presented) The method of claim 1 wherein the exposing comprises flowing the mixture comprising O_2 and H_2 over the heated substrate for a time in a range about 10 seconds to about 500 seconds.

15. (previously presented) The method of claim1 wherein the exposing comprises flowing the mixture comprising O_2 and H_2 over the heated substrate for a time in a range about 30 seconds to about 300 seconds.

16. (previously presented) The method of claim 1 wherein the exposing comprises heating the substrate in a furnace and flowing the mixture comprising O_2 and H_2 into the furnace, whereby components of the mixture comprising O_2 and H_2 react to produce $O^{\bullet}$ near the heated substrate.

17. (previously presented) The method of claim 16 wherein flowing the mixture comprising O_2 and H_2 further comprises flowing a carrier gas.

18. (previously presented) The method of claim 17 wherein flowing the mixture comprising O_2 and H_2 further comprises flowing N_2 as a carrier gas.

19. (previously presented) The method of claim 16 wherein flowing the mixture comprising O_2 and H_2 comprises flowing O_2 and H_2 at selected proportional flow rates.

20. (previously presented) The method of claim 19 wherein flowing the mixture comprising O_2 and H_2 further comprises flowing N_2 as a carrier gas at a selected flow rate.

21. (previously presented) The method of claim 19 wherein flowing O_2 and H_2 comprises flowing O_2 and H_2 at a combined flow rate in a range about 1 to about 40 slm.

22. (previously presented) The method of claim 20 wherein flowing O_2 and H_2 comprises flowing O_2 and H_2 at a combined flow rate in a range about 1 to about 40 slm, and flowing N_2 comprises flowing N_2 at a flow rate up to about 50 slm.

23. (previously presented) A method for manufacturing a semiconductor device having an ONO structure, comprising:

providing an oxide-nitride film on a surface of a substrate, the substrate having first and second regions defined by an isolation, the oxide-nitride film including a first silicon oxide layer over the substrate and a silicon nitride layer over the first silicon oxide layer;

patterning the oxide-nitride film to expose a surface of the substrate in the second region and to define bottom oxide and silicon nitride portions of an ONO stack in the first region of the substrate, the bottom oxide portion and silicon nitride portions having exposed sidewalls and the silicon nitride portion having an exposed surface; and

performing a ISSG operation by heating the substrate to a temperature in a range about 700 °C to about 1200 °C and, while the substrate is at a temperature in said range, exposing the exposed sidewalls and the exposed surface to a gas mixture comprising O_2 and H_2 in a proportion in a range about 0.1% to about 40% (H_2 / $H_2 + O_2$) at a pressure in a range about 1 torr to about 20 torr for a time in a range about 1 to 1000 seconds, whereby components of the gas mixture react to produce a radical oxidizing agent near the heated substrate, to form concurrently a second oxide layer on the exposed surface and sidewalls of the patterned silicon nitride portion and a gate oxide layer on the substrate surface in the second region; and

forming a conductive layer over the second oxide layer and over the gate oxide layer.

24. (original) The method of claim 23 wherein the radical oxidizing agent comprises an oxygen radical.

25. (original) The method of claim 23 wherein the radical oxidizing agent comprises $O^{\bullet}$.

26. (canceled)

27. (previously presented) The method of claim 23 wherein heating the substrate comprises heating the substrate to a temperature in a range about 900 °C to about 1150 °C.

28. (previously presented) The method of claim 23 wherein heating the substrate comprises heating the substrate to a temperature in a range about 850 °C to about 1000 °C.

29. (previously presented) The method of claim 23 wherein the exposing comprises heating the substrate to the temperature in the temperature range and exposing the exposed sidewalls and the exposed surface to a gas mixture comprising O_2 and H_2 in a proportion in a range about 0.1% to about 40% (H_2 / H_2 + O_2) at a pressure in a range about 1 torr to about 20 torr for a time in a range about 1 to 1000 seconds, whereby components of the O_2 and H_2 react to produce $O^{\bullet}$ near the heated substrate.

30. (cancelled)

31. (cancelled)

32. (cancelled)

33. (previously presented) The method of claim 23 wherein the exposing comprises flowing over the heated substrate a mixture comprising O_2 and H_2 in a proportion in a range about 5% to about 33% (H_2 / H_2 + O_2).

34. (previously presented) The method of claim 23 wherein the exposing comprises flowing over the heated substrate a mixture comprising O_2 and H_2 in a proportion in a range about 1:19 to about 1:2 (H_2 : O_2).

35. (previously presented) The method of claim 23 wherein the exposing comprises flowing the mixture comprising O_2 and H_2 over the heated substrate for a time in a range about 10 seconds to about 500 seconds.

36. (previously presented) The method of claim 23 wherein the exposing comprises flowing the mixture comprising O_2 and H_2 over the heated substrate for a time in a range about 30 seconds to about 300 seconds.

37. (previously presented) The method of claim 23 wherein the exposing comprises heating the substrate in a furnace and flowing the mixture comprising O_2 and H_2 into the furnace, whereby components of the mixture comprising O_2 and H_2 react to produce $O^{\bullet}$ near the heated substrate.

38. (previously presented) The method of claim 37 wherein flowing the mixture comprising O_2 and H_2 further comprises flowing a carrier gas.

39. (previously presented) The method of claim 38 wherein flowing the mixture comprising O_2 and H_2 further comprises flowing N_2 as a carrier gas.

40. (previously presented) The method of claim 37 wherein flowing the mixture comprising O_2 and H_2 in a selected proportion comprises flowing O_2 and H_2 at selected proportional flow rates.

41. (previously presented) The method of claim 40 wherein flowing the mixture comprising O_2 and H_2 further comprises flowing N_2 as a carrier gas at a selected flow rate.

42. (previously presented) The method of claim 40 wherein flowing O_2 and H_2 comprises flowing O_2 and H_2 at a combined flow rate in a range about 1 to about 40 slm.

43. (previously presented) The method of claim 41 wherein flowing O_2 and H_2 comprises flowing O_2 and H_2 at a combined flow rate in a range about 1 to about 40 slm, and flowing N_2 comprises flowing N_2 at a flow rate up to about 50 slm.

44. (original) The method of claim 23 wherein a ratio of thicknesses of the formed second oxide layer and the formed gate oxide layer is in a range about 0.6:1 to about 0.8:1.

45. (previously presented) The method of claim 23 wherein heating the substrate comprises holding the substrate at a temperature in the temperature range for a time in a range about 10 seconds to about 500 seconds.

46. (previously presented) The method of claim 23 wherein heating the substrate comprises holding the substrate at a temperature in the temperature range for a time in a range about 30 seconds to about 300 seconds.

47. (previously presented) A method for manufacturing a memory device having an ONO structure, comprising:

providing an oxide-nitride film on a surface of a substrate, the substrate having first and second regions defined by an isolation, the oxide-nitride film including a first silicon oxide layer over the substrate and a silicon nitride layer over the first silicon oxide layer;

patterning the oxide-nitride film to expose a surface of the substrate in the second region and to define bottom oxide and silicon nitride portions of an ONO stack in the first region of the substrate, the bottom oxide portion and silicon nitride portions having exposed sidewalls and the silicon nitride portion having an exposed surface; and

performing a ISSG operation by heating the substrate to a temperature in a range about 700 °C to about 1200 °C and, while the substrate is at a temperature in said range, exposing the exposed sidewalls and the exposed surface to a gas mixture comprising O_2 and H_2 in a proportion in a range about 0.1% to about 40% (H_2 / $H_2 + O_2$) at a pressure in a range about 1 torr to about 20 torr for a time in a range about 1 to 1000 seconds, whereby components of the gas mixture react to produce a radical oxidizing agent near the heated substrate, to form concurrently a second oxide layer on the exposed surface and sidewalls of the patterned silicon nitride portion and a gate oxide layer on the substrate surface in the second region; and

forming a conductive layer over the second oxide layer and over the gate oxide layer.

48. (original) The method of claim 47 wherein the radical oxidizing agent comprises an oxygen radical.

49. (original) The method of claim 47 wherein the radical oxidizing agent comprises $O^{\bullet}$.

50. (canceled)

51. (previously presented) The method of claim 47 wherein heating the substrate comprises heating the substrate to a temperature in a range about 900 °C to about 1150 °C.

52. (previously presented) The method of claim 47 wherein heating the substrate comprises heating the substrate to a temperature in a range about 850 °C to about 1000 °C.

53. (previously presented) The method of claim 47 wherein the exposing comprises heating the substrate to the temperature in the temperature range and exposing the exposed sidewalls and the exposed surface to a gas mixture comprising O_2 and H_2 in a proportion in a range about 0.1% to about 40% (H_2 / H_2 + O_2) at a pressure in a range about 1 torr to about 20 torr for a time in a range about 1 to 1000 seconds, whereby components of the mixture comprising O_2 and H_2 react to produce $O^{\bullet}$ near the heated substrate.

54. (canceled)

55. (canceled)

56. (canceled)

57. (previously presented) The method of claim 47 wherein the exposing comprises flowing over the heated substrate a mixture comprising O_2 and H_2 in a proportion in a range about 5% to about 33% (H_2 / H_2 + O_2).

58. (previously presented) The method of claim 47 wherein the exposing comprises flowing over the heated substrate a mixture comprising O_2 and H_2 in a proportion in a range about 1:19 to about 1:2 ($H_2 : O_2$).

59. (previously presented) The method of claim 47 wherein the exposing comprises flowing the mixture comprising O_2 and H_2 over the heated substrate for a time in a range about 10 seconds to about 500 seconds.

60. (previously presented) The method of claim 47 wherein the exposing comprises flowing the mixture comprising O_2 and H_2 over the heated substrate for a time in a range about 30 seconds to about 300 seconds.

61. (previously presented) The method of claim 47 wherein the exposing comprises heating the substrate in a furnace and flowing the mixture comprising O_2 and H_2 into the furnace, whereby components of the mixture comprising O_2 and H_2 react to produce $O^{\bullet}$ near the heated substrate.

62. (previously presented) The method of claim 61 wherein flowing the mixture comprising O_2 and H_2 further comprises flowing a carrier gas.

63. (previously presented) The method of claim 62 wherein flowing the mixture comprising O_2 and H_2 further comprises flowing N_2 as a carrier gas.

64. (previously presented) The method of claim 61 wherein flowing the mixture comprising O_2 and H_2 comprises flowing O_2 and H_2 at selected proportional flow rates.

65. (original) The method of claim 64 wherein flowing the mixture of O_2 and H_2 further comprises flowing N_2 as a carrier gas at a selected flow rate.

66. (previously presented) The method of claim 64 wherein flowing O_2 and H_2 comprises flowing O_2 and H_2 at a combined flow rate in a range about 1 to about 40 slm.

67. (previously presented) The method of claim 65 wherein flowing O_2 and H_2 comprises flowing O_2 and H_2 at a combined flow rate in a range about 1 to about 40 slm, and flowing N_2 comprises flowing N_2 at a flow rate up to about 50 slm.

68. (original) The method of claim 47 wherein a ratio of thicknesses of the formed second oxide layer and the formed gate oxide layer is in a range about 0.6:1 to about 0.8:1.

69. (previously presented) The method of claim 47 wherein heating the substrate comprises holding the substrate at a temperature in the temperature range for a time in a range about 10 seconds to about 500 seconds.

70. (previously presented) The method of claim 47 wherein heating the substrate comprises holding the substrate at a temperature in the temperature range for a time in a range about 30 seconds to about 300 seconds.

71. (canceled)

72. (canceled)

73. (canceled)